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Review

Guides or gatekeepers? Incumbent-oriented transition intermediaries in a low-carbon era

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ABSTRACT

Transitions intermediaries—agents who connect diverse groups of actors involved in transitions processes and their skills, resources and expectations—are becoming more prominent in research on low-carbon transitions. Most work, however, has focused on their ability to push innovations or emerging technologies forward, emphasising their involvement in disrupting incumbent regimes or firms. However, in focusing on new entrants, often at the grassroots level, such literature runs the risk of overlooking the potentially positive role that *incumbent transition intermediaries*—those oriented to work with or centrally consider the interests of dominant government, market or civic stakeholders—can play in meeting sustainable energy and transport goals. In this paper, we focus specifically on five different incumbent transition intermediaries—Smart Energy GB in the United Kingdom, Energiesprong in the Netherlands, SULPU in Finland, CERTU in France, and the Norwegian Electric Vehicle Association —and explain their efforts to meet socially desirable goals of accelerating innovation or decarbonizing energy or transport systems. We ask: Why were these intermediaries created, and what problems do they respond to? How do they function? What are their longer-term strategies and aspirations? In what ways do they reflect, reinforce, or otherwise shape incumbency? In answering these questions via a comparative case study approach, the paper aims to make contributions to the study of incumbency and intermediation in the context of transitions, to identifying different types of incumbent intermediaries (market, governmental, civic), and to informing debates over energy and climate policy and politics.

1. Introduction

The decarbonisation of energy and transport systems is among the most important international challenges facing society [1–4], with concomitant calls for purposeful innovation with technologies, institutions, behaviours, and even entire systems. Transition intermediaries—agents who connect diverse groups of actors involved in transitions processes and their skills, resources and expectations—are becoming increasingly prominent in research on both innovation and low-carbon transitions [5]. This is partly because intermediaries can help overcome important system failures and deficits commonly slowing down the development of innovations (e.g. knowledge codification and circulation, network and alliance formation, demand articulation) [6]. Private and corporate actors are often dependent on start-ups or research institutes for emerging innovation opportunities [7,8]. These actors will frequently rely in part on intermediaries to broker access to such knowledge, foster new collaborative relationships, or facilitate technology transfer [9] – particularly for path-breaking innovation efforts.

A host of studies have generally confirmed the value that intermediaries can play in innovation processes or in reconfiguring sociotechnical systems such as energy or transport. For example, Klerkx and Leeuwis [10] argue that intermediaries fulfil a vital role in innovation ecosystems by overcoming informational, cognitive, and managerial gaps. Van Lente et al. [11] developed the notion of “systemic intermediaries” that can link actors and coordinate innovation activities at the level of a network, rather than an isolated technology or bilateral relations. Moss [12] envisions intermediaries also as political actors

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serving as a go-between in addressing collective action problems, clashes of interests, and conflicting values. Intermediaries have also been found to play a critical role in negotiating and configuring innovation processes between novel solutions and their users [13,14]. Stewart and Hyysalo [15] suggest that collaborative functions may be more prominent and warranted in the case of innovation addressing societal needs. Others highlight that the inherently purposeful and normatively-oriented character of sustainability transitions and related innovations (i.e. addressing societal challenges) warrants specific kinds of intermediation [5] that are more attuned to experimentation [16], institutional rule-change [17], political advocacy work [18], championing strategies [19], and an explicit focus on disrupting incumbents [10,20].

In the context of sustainability transitions, intermediation is approached as potential support for correcting asymmetries (e.g. between challengers and incumbents) [12], catalysing bottom-up scaling mechanisms [21,22], or strengthening socio-technical niches from the obstructive or predatory influence of established regimes [23]. Mignon and Kanda [24] suggest a useful distinction between a) the scope of intermediary action (e.g. whether they focus on niches or regimes as an entry point, whether they target specific actors or entire systems), and b) the kinds of recipients considered (for which they distinguish between supply-side and user-side intermediaries). Regardless, however, they suggest that while different analytical distinctions are useful and relevant, they do not yet offer conclusive implications tying different kinds of intermediation types with specific functions performed. Schot et al. [25] and Kanger and Schot [26] talk about the salient role that "user-intermediaries" play in fostering sustainability transitions, but never further differentiate intermediary types in their analysis.

Much work on intermediaries in transitions, such as energy, has focused on their disruptive nature and emphasized their ability to push "niches" or emerging technologies into socio-technical environments [27,28,22,18]. This work connects to an initial need for protecting and nurturing such activities from established actors and institutions through "protective spaces" [29]. Accordingly, this body of literature focuses on how intermediaries can facilitate processes that challenge established regimes (e.g. through aggregation of learning, providing advice, creating networks and aiming to shape policy) "from the ground up". This focus is in part explained by an overwhelming emphasis on early stages of transitions [5] – although this is changing, notably around the increasingly fruitful operationalisation of different forms of niche empowerment articulating niche-regime interactions [30] and focus on diffusion intermediaries [31].

Indeed, in focusing on breakthroughs, new entrants, and radical novelty creation, often at the grassroots level, and possibly downplaying the role of incumbents, such literature runs the risk of overlooking the various roles that *incumbent-oriented transition intermediaries*—those that centrally consider the interests of established government, market or community stakeholders—can play in furthering sustainability transitions. Initially attention was paid by Kivimaa et al. [5] on how some transition intermediaries are tied to the established regime via their mandate or establishment. This study expands from this starting point by exploring the ways in which a range of market, civil or institutional intermediaries relate to incumbency. In this context, this study maps out issues and challenges with incumbent-oriented intermediation in the context of low-carbon or sustainability transitions. To do so, it asks four questions about transition intermediaries engaging with incumbents:

1 What problems do the intermediaries respond to?
2 How do the intermediaries function?
3 What are their longer-term visions and strategies (if any)?
4 In what ways do they reflect, reinforce, or otherwise shape incumbency?

These questions are addressed using a qualitative case study approach, based on a selection of five case studies assuming a variety of incumbent-oriented intermediation functions and roles, in different sections related to energy demand.

Answering these questions via a varied set of empirical cases is important, as it enables us to explore the different ways of engaging constructively with incumbency in transitions, particularly as transitions dynamics acquire momentum, and in the context of renewed debate about the need for deeper engagement with incumbency [32,33]. By choosing cases of intermediary actors that engage with incumbents in the context of transitions, we empirically compensate for what we see as an implicit bias for emphasizing the dynamics of challengers (at the possible expense of exploring the dynamics of incumbents).[1] Moreover, we explore a variety of intermediary strategies and inclinations that may inform more deductive typologies. This paper is organised as follows. Section 2 outlines our conceptual approach on incumbent-oriented intermediaries. Section 3 presents our research design and case study methodology and rationale for case selection. Section 4 presents the five empirical cases, followed by reflections and implications in Section 5 34. Section 6 concludes.

2. Conceptual approach: Incumbency, intermediation, and incumbent-oriented intermediaries in the context of low-carbon transitions

In this section, we define intermediaries and their various functions in transitions, we define incumbents and specify difficulties faced in the context of the "dual challenge" of sustainability transitions [35], and build on this to outline our core conceptual device of incumbent-oriented intermediaries.

Justifying our focus is an apparent lack of deep engagement in the existing literature, with only rare instances of connections between the body of work on intermediaries (i.e. innovation intermediaries, transition intermediaries) and the distinction of industry actors in terms of their incumbency (i.e. incumbent vs. new entrant or challenger). Indeed, a rapid review on Scopus only returned three instances where the term "incumbent intermediary" or "incumbent intermediation" had been explicitly used. This was in connection to general market activity [36–38], disconnected from innovation or transition studies.

Widening our rapid review search to explicit associations between the radicals "incumben~" and "intermedia~", filtering out irrelevant results, we found three articles that make some connection between the two. Meckling and Nahm [39] focus on interest intermediation in the context of achieving transformation towards electric vehicles. They note how political coordination efforts may result in industry and government actors to act as intermediaries that prioritises the interests of incumbent companies, while political competition makes better allowances to create coalitions among challengers of incumbent technology. Dodourova and Bevis [40] talk about formal and informal networks in the European car industry, the former typically having incumbents as members and being better resourced. Matschoss and Heiskanen [16] describe the work of an innovation intermediary, owned by the City of Helsinki, in Finland, in destabilising the work of an energy incumbent. The City of Helsinki is also regarded as an incumbent although not examined in the study. Their study analyses "the mechanisms through which the intermediary interacts with incumbents and niche actors to challenge existing regime rules" (p. 1456).

2.1. Intermediaries and intermediation functions

There are several definitions of what an intermediary is, with perhaps the concept of financial intermediaries such as banks or credit

[1] While the literature on innovation intermediaries does not carry such a bias – and indeed engages largely with the knowledge, collaboration and technology transfer issues of large firms – the transitions literature has to date overemphasised bottom-up logics which this paper in part seek to compensate for.

unions serving as a classic example [41]. Moss ([12]: 1482) admits that "intermediaries can take very different forms" ranging from individuals to organizations, networks, and platforms. Howells ([42]: 720) more specifically defines an "innovation intermediary" as "an organization or body that acts an agent or broker in any aspect of the innovation process between two or more parties." Stewart and Hyysalo ([15]: p. 295) define innovation intermediaries as "actors who create spaces and opportunities for appropriation and generation of *emerging* technical or cultural products by others who might be described as developers and users." Howells [42] makes a distinction between technological diffusion and transfer (for which negotiation, collaboration, and knowledge brokering skills are key), and system transformation (for which intermediaries play a much wider institutional role "in the strategic level between the policy level and the operational level […] and how they form an 'ecology' of influences on other agents within the system" ([42]:717)).

As an example, Kivimaa and Martiskainen [43] illustrate a significant range of intermediaries operating just within the UK low-energy housing sector and its policy-innovation interface, comprising, for example, government-initiated agencies, charities and social enterprises, membership organisations and network organisations. Elsewhere, a range of other actors, including architects [44], building managers [13] and religious congregations [45] have been found to intermediate for change in this sector more locally. Schot et al. ([25]: 4) argue that even users can function as intermediaries as they "create space for the appropriation, shaping and alignment of the various elements of emerging socio-technical systems, such as products, infrastructures and regulatory frameworks". In this context, user-intermediaries are important actors in a transition as they can help voice expectations and interpretations of new technologies, influence user needs, create user representations and connect different actors [26,25].

Overall, the literature shows a significant variety of actors that are (at times) identified to take intermediary roles. In addition, also different conceptual archetypes of intermediaries are presented in the literature. Table 1 shows 16 different intermediary actor types as well as 10 different conceptual archetypes.

Innovation intermediaries are typically identified based on functions or activities they undertake. They are understood to fulfil a variety of bridging functions between actors' activities, skills and resources in relation to common challenges related to innovation processes. Indeed, Table 2 summarizes at least 18 (!) different functions under different processes relevant for innovation and transitions, drawn from the literature. Intermediaries can be seen as addressing significant gaps and failures in innovation systems and processes [11,42,50], including information, managerial, cultural and cognitive gaps [51] – although they are not necessarily created to fulfil such explicit purposes [12]. In the sustainability transitions literature, this activity is extended to transforming socio-technical systems more broadly.

Table 1
Actor types and conceptual archetypes of intermediaries.
Source: Authors compilation

Actor types that may take on intermediary roles	Conceptual archetypes of intermediaries
Membership organisations [46]	Systemic intermediaries [11]
Government-initiated agencies [17]	Strategic intermediaries [13]
Social enterprises [46]	Regime-based transition intermediaries [5]
Charities [46]	Institutional intermediaries [17]
Network organisations [46]	Niche intermediaries [49]
Building managers [13]	Network intermediaries [43]
Architects [44]	User-intermediaries [25,47]
Religious congregations [45]	Process intermediaries [5]
Internet platforms [47] [14]	Interpretive intermediaries [44]
Lead users [25]	Middle actors [45]
Local authorities [43]	
Energy agencies [48]	
Innovation agencies [17]	
Consultants [42]	
Technology transfer agencies [42]	
Universities [42]	

Table 2
The varied functions of intermediaries in sustainability transitions.
Source: Authors complication

Knowledge and learning
Knowledge gathering, processing, generation and combination [42,52]
Facilitating experimentation [16,28]
Aggregation and circulation of knowledge [15,48]
Providing advice and support [10,27]
Networking
Creating and managing networks [10,15]
Translating between actors and interests [12,18]
Trust building and conflict resolution [42,53]
Brokering
Brokering by representing organizations and negotiation on their behalf [[15]]
Brokering between actors and interests [12,18]
Financial brokering by raising monetary support [15,42]
Innovation & diffusion
Innovation process management [27,42]
Technology transfer [[42]]
Connecting new technology and users [13,47]
Visioning
Articulation of expectations, requirements and visions [11,21]
Institutional
Political advocacy & lobbying [18,48]
Policy implementation [54,55]
Legitimizing institutional change [[28]]
Developing standards [[55]]

More recently, it has been argued that sustainability transitions call for "ecologies of intermediaries" [5,14,43], reflecting the variety of actors, functions, and innovations that need to be brought in alignment to enable transitions. While such ecologies do not rule out incumbent-oriented intermediaries, the previous literature has not conceptually recognized or addressed such intermediaries in specific terms [11,29,56].

Concerning institutional changes that shape transitions contexts, common hurdles include uncertainties about the directionality of change (e.g. inexistent, weak or confusing standards), poorly articulated user preferences, norms and standards, constraining/enabling policy change (e.g. lagging, watered down or incoherent change in policy context), or active resistance to change from actors in established fields. Accordingly, transition intermediaries may help address institutional system failures by a) facilitating access to decision-making and lobbying for more stringent regulatory change [19]; b) creating and sustaining advocacy coalitions [18], including in between conflicting actor interests ([52]; [5]); c) articulating and shaping collective expectations [21]; d) developing and strengthening standards [55] or certification schemes; or e) legitimising institutional change [28], namely by generating conditions where trust can overcome prevailing power, knowledge and resource asymmetries [57] or by empowering emerging actors, entities or discourses to bear on or overtake established configurations [58].

2.2. Incumbents and the dual challenge of sustainability transitions

Drawing from Johnstone et al. ([59]:152), we define incumbent actors or institutions as those "that often have vested interests in maintaining the status quo rather than enabling transitions and will often act to strategically protect their privileged position" within a given socio-technological regime. Incumbents tend to be powerful, materially resourceful, politically influential, societally authoritative, strategically conservative and risk-averse [32,60]. Incumbency is a powerful competitive advantage in the context of stable economic and socio-political environments, as it enables, among others, the fruition of economies of scale, control over key resources, and leveraging political

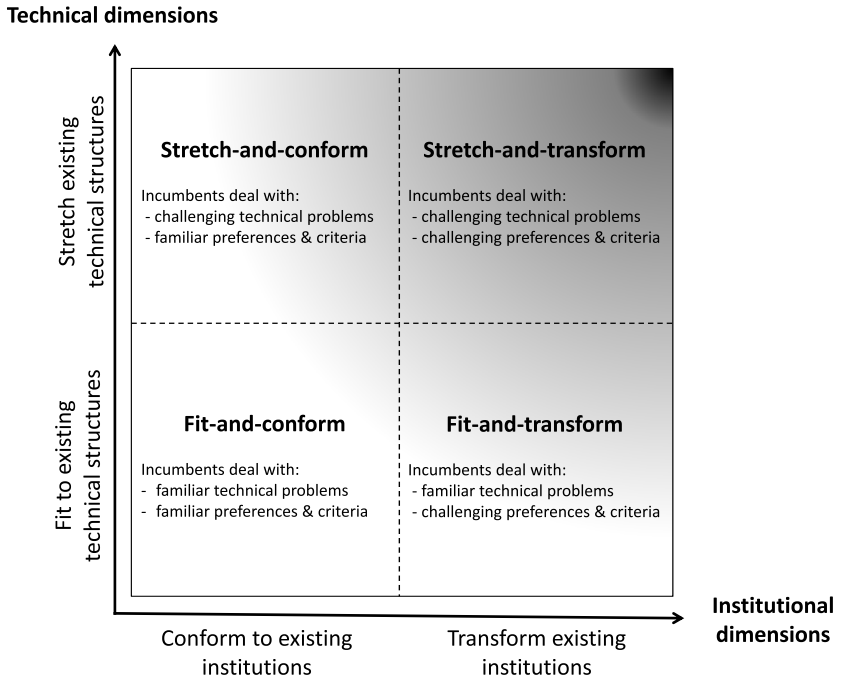

Fig. 1. The dual challenge of transitions for incumbents

and regulatory influence.

However, incumbency can be challenging in the face of path-breaking innovations. Sustainability transitions present a dual challenge, as they require the development of path-breaking socio-technical innovation at the same time as the development of new preferences, selection criteria and changes on socio-political dimensions [35].

Incumbent actors face significant difficulties in the face of radical innovation brought about by challengers [34], which may disrupt existing activities with acute to chronic consequences. Common explanations for incumbent's difficulties include managerial cognitive failures preventing the adequate recognition of disruptive threats [61,62], growing misalignments with core capabilities that can turn into core rigidities [63,64], commitments to technological competences, investment patterns [65], technological paradigms or value networks, a tendency of established actors for exploitative innovation over exploratory strategies [66], or deeper struggles when innovations challenge the core mission, identity and belief structures of industry actors [67]. Consequently, incumbents may have lower incentives to engage with radical innovation.

Perhaps more challenging even, sustainability innovations can involve new prescriptive criteria for innovative activities that are inherently normative and concern institutional dimensions of change. This means that the directionality of innovation is important in sustainability transitions: socio-cultural and environmental objectives can be equally important as economic or technical objectives [68]. In some cases, such socio-cultural and environmental objectives precede them as a *raison d'être* – as in the case of low-carbon innovation that derives its market from a need to address a societal challenge and open up alternative innovation paths. A direct consequence of this socio-political dimension is that innovative economic activity can become polarised between those advocating ambitious new paths and associated standards (typically "niche actors") and those supporting the status quo (typically "regime actors"), where issues of directionality, legitimacy and responsibility become even more central [69]. Here again, a recurring hypothesis is that radical sustainability innovation is more likely to come from small new entrants than incumbents [28,29,70]. Further, those new entrants that are committed to value-based approaches [71] often derive their legitimacy from their "idealist" mission, position themselves in distinction to established market players and tend to have a preference for keeping innovation niches beyond the reach of "predatory" incumbent influence (e.g. co-opting, buy-out, dilution or weakening of standards) [72]. At any rate, negotiating the institutional, socio-political and normative tensions between emergent niches and established regimes is a central theme of sustainability transitions research - warranting an exploration of usual assumptions, namely concerning the role of incumbents. But despite its broad scope, and rich empirical data, such scholarship may be unduly simplifying how it engages with incumbency and incumbents.

In order to map out how this dual challenge [35] plays out for incumbents, we borrow a representation from the niche empowerment literature ([30] [29]). This literature problematises the development and widespread diffusion of niche-innovations as related the transgressing boundaries between a) the "protected spaces" offered by socio-technical niches (wherein innovations can be shielded from mainstream selection pressures and nurtured to acquire greater momentum and maturity); and b) mainstream selection environments and regimes (wherein established actors and incumbents may benefit from inherent advantages). Accordingly, the niche empowerment literature distinguishes different paths according to the degree of departure from mainstream selection environments: *fit-and-conform* paths are understood as "processes that make niche innovations competitive within unchanged selection environments" while *stretch-and-transform* paths are understood as "processes that contribute to *changes* in mainstream selection environments in ways favourable to a path-breaking niche innovation" [29]. Furthermore, with reference to the dual challenge of sustainability transitions [35], we suggest disentangling technical dimensions, i.e. the degree to which innovations depart from existing competences (fitting to or stretching them), from institutional dimensions, i.e. the degree to which they depart from prevailing institutional criteria and logics (conforming to or transforming them).

Figure 1 links empowerment to the dual challenge of sustainability transitions (across technical and institutional dimensions) and applies it to suit our specific focus on incumbency. Each quadrant provides an ideal-typical representation of the extent to which incumbents may be operating in a familiar or challenging space, based on combinations of the degree to which they depart from mainstream technical and institutional dimensions. Accordingly, the background shading represents the extent to which incumbents can be expected to find themselves out

Table 3
An overview of five intermediary cases.

Intermediary	Type	Country	Core socio-technical process supported
Smart Energy GB	Government	UK	Promoting smart meters
Energiesprong	Market	NL / UK	Facilitating household zero-energy efficiency retrofits
CERTU	Government	FR	Diffusion of electric trams and reconfiguring public transport
SULPU	Market	FI	Accelerated the diffusion of heat pumps
NEVA	Civic	NO	Supporting battery electric vehicles

of their comfort zone regarding e.g. core competences, institutional criteria, or user preferences, with the top-right quadrant entailing the more challenging situation. Furthermore, it may be posited that the mainstreaming of innovation would entail a movement from the top-right corner to the bottom-left corner of the solution space.

2.3. Sketching the contours of incumbent-oriented transition intermediaries

Given this dual challenge, we argue that there is a need for attending specifically to what we name *incumbent-oriented transition intermediaries,* in order to address a lack of specific attention on how transition intermediaries engage with incumbent actors. We argue that incumbent-oriented transition intermediaries refer most broadly to those that intermediate—i.e. connect diverse groups of actors [5]—on behalf of or in the interest of incumbents engaged with sustainability transitions. In doing so, we tread aware that such a distinction may be hard to delineate: while it may be possible to identify and analytically exclude those intermediaries that actively avoid incumbents (e.g. due to incompatibilities with particular framings of emancipatory visions of change), *incumbent-oriented transition intermediaries* are likely to manifest a variety of non-exclusive forms of engagement with incumbents and other actors. In some cases, they may be created by incumbents; in others, they may be funded by them. In still others, they may simply work closely with them (exclusively, punctually, or otherwise). We offer a working definition of:

> Organisations or individuals engaging knowingly and directly with incumbent actors and their potential to contribute to innovation for sustainability transitions, acting as agents, brokers or architects in any aspect of the change process between two or more parties.

The distinguishing feature here is the recognition that incumbents could support or shape transitions from the outset– an understudied relationship in our view.

Similarly, the notion of a "regime-based transition intermediary," coined by Kivimaa et al [5] and used by Manders et al. [73], and defined as tied to established interests or institutional arrangements typical of prevailing socio-technical regimes and explicitly mandated by "dominant regime actors," recognises significant scope for working within, across, and beyond the boundaries of existing industry templates. These so-called "regime-based transition intermediaries" are even stated to be in a position to work against other intermediaries, in their quest to maintain the socio-technical configurations of the status quo ([5]: 1072). So, there is a lively and emerging debate about the interaction of transition intermediation and incumbency. Within this debate, we suggest that our focus on incumbent-oriented transition intermediaries is slightly broader than regime-based transition intermediaries, in three main ways: 1) it is more open concerning the origin of their mandate (which does not necessarily stem directly from regime actors); 2) it does not presuppose a particular positioning vis-à-vis emerging niches as it includes strategies supporting a single niche or a multiplicity of niches (indeed, most of our cases provide evidence for the former); 3) our intermediary cases do not seek to always disrupt the status quo nor do they actively interrupt the activities of other intermediaries.

Below we explore the role of our five incumbent-oriented intermediaries along the dual challenge of sustainability transitions to introduce path-breaking change along techno-economic boundaries and institutional boundaries. We also recognise that path-breaking change can take a variety of forms, from incremental to more radical, and we problematize such distinction along a continuum.

3. Research methods: Case study approach and case selection

We relied on a qualitative case study approach. Our data collection process included (1) a desk-based review of relevant academic literature on incumbency and intermediaries; (2) a qualitative selection of five cases representing incumbent-oriented intermediaries in different industrial sectors related to energy demand (see Table 3); and (3) subsequent document analysis pertinent to each case.

In selecting our cases for exploratory purposes, we sought to maximize diversity of incumbent types and variation along analytically relevant dimensions. Our cases thus represent different sectors (buildings, mobility, energy and heat) and different societal spheres (government, community, and market). Although there are clear overlaps between these domains, we selected cases that involved:

- Governmental and regulatory incumbent-oriented intermediaries that tend to focus on extending or retaining some sort of political authority or policy influence over the direction and content of socio-technical change, policy, or regulation. Their agenda is primarily to harness innovation as means to deliver political objectives and fulfil mandates, or to consolidate their position (e.g. role of public action, role of local politics) by strategically extending the scope of their influence. Some governmental intermediaries act as regulatory intermediaries, sitting between formal rule-makers or regulators and rule-takers or targets [41]. They are often stipulated by law to champion a project, e.g. organisations or bodies set up explicitly to provide credit to low-carbon infrastructure, or the promotion of regulatory compliance and conformity with national targets or standards (for things like electric vehicle charging or grid stability). Governmental intermediaries can also serve the existing "technical bureaucracy" of the state, i.e. intermediating between different levels of government (and related "mission", in our cases public transport and planning and smart metering) and with project implementation actors (industry, mayors, project developers). Accordingly, governmental intermediaries may have a stronger mandate to fulfil their specific function. Our case studies of this type are Smart Energy GB, tasked with implementing the national smart meter program throughout England, Scotland, and Wales, as well as the government-affiliated CERTU in France.
- Market or business incumbent-oriented intermediaries that focus on the delivery of products and services by the private sector. Their agenda is essentially to promote particular business models, new technologies or practices that can improve these services, generate financial returns/savings, grow new firms or create new markets, products or services. They include amongst others: management consultancies; innovation hubs; trade associations, labour unions; and business forums. Our case study examples here are the "Energiesprong" domestic energy efficiency market development team in the Netherlands and SULPU heat pump association in Finland.
- Civic incumbent-oriented intermediaries that attempt to retain or

claim control over public or civil society networks, user groups, or individual citizens. It can include civil society organizations such as Friends of the Earth, user associations such as the Automobile Association, or advisory groups such as Citizens Advice, having established themselves as primary interlocutor or representative of users and/or citizens. Our case study example here is the user-based Norwegian Electric Vehicle Association (NEVA).

Within these cases, because our research goals are largely exploratory (seeking to map out issues and challenges with incumbent-oriented intermediation in the context of low-carbon transitions), our selection of cases maximises variation along a number of dimensions, enabling us to "obtain information about the significance of various circumstances for case process and outcome" [74].

Accordingly, our case selection spans innovations in a variety of sectors (energy, buildings, transport), societal realms (government, market, users/civil society) [75], and processual focus (innovation diffusion, system transformation) [42]. Furthermore, because our cases discuss the role of intermediaries as related to a particular kind of innovation, these also present varying degrees of radicalism with respect to established technical competences and normative criteria (we discuss how they differ in terms of their degree of challenge for incumbents and their technical and institutional dynamics in section 5.2). Incidentally, the intermediaries we study also span the overlapping intermediation roles and functions presented above in Table 1 and Table 2, which is a running theme in the intermediaries literature [5,42,56].

Based on these five cases, we explain their efforts to meet socially desirable goals of accelerating low-carbon innovation or decarbonizing energy or transport systems. Each of these intermediaries reflects some aspect of working with incumbents, addressing elements of the dual challenge of sustainability transitions [35]. To examine each intermediary, our research protocol was guided by the following operational questions: "Why was it created, and what problems does it seek to address?" "How does it function?" "What is its longer-term vision and strategy?" "In what ways does it reflect, reinforce, or otherwise shape incumbency?"

4. Results and discussion: An exploration of incumbent-oriented transitions intermediaries in five cases

In this section, as summarized by Table 4, we examine the intermediation strategies of five distinct incumbent-oriented innovation intermediaries. As Table 4 indicates, these intermediaries cover a mix of different technologies (smart meters, zero energy homes, trams, electric vehicles and heat pumps) as well as functions (from communication and awareness to business model implementation and knowledge circulation). They also operate across different spheres, from governmental (involving political and regulatory entities) to market (involving private sector and for profit entities) and civic (involving community or user entities). Section 5 will elaborate more on these findings, after the cases are presented.

4.1. Smart Energy GB in Great Britain (2013 to 2024)

Smart Energy GB is an independent not-for-profit company created by the British government in 2013 to manage the communications and engagement around the smart meter rollout to households and small businesses in Great Britain. Although the smart meter rollout emphasizes consumer engagement, it has been delivered through energy firms (incumbents as well as challengers) and the intermediary Smart Energy GB has been the main facilitator of the consumer engagement campaign. It intermediates between users on the one hand and government and industry on the other hand.

We classify Smart Energy GB as a governmental incumbent-oriented intermediary. It is not an energy supplier and does not install smart meters. Its role is to ensure everyone in Great Britain understands smart

Table 4
An overview of five incumbent-oriented intermediaries and their actors, objectives, and resources.
Source: Authors.

Name	Created	Type	Breadth of technical competences	Created by	Country	Actors	Main objectives	Resources
Smart Energy GB	2013	Governmental	Narrow, technology-specific (smart meters)	Government and incumbent energy suppliers	UK	Government, BEIS, Ofgem, energy suppliers, equipment installers, consumers	Communication, awareness, advertising about the national smart meter rollout	High: budget of £234 million
Energiesprong	2013	Market	Sector-specific (multiple retrofit technologies, zero carbon homes)	Government, Housing providers, construction companies, trade bodies	NL, UK	Construction firms, housing providers, energy efficiency companies	Create a market for zero carbon homes, business models innovation, stakeholder coordination, advocacy	Moderate: €50 million grant
Study Centre for Networks, Transport, Urbanism and Public Works (CERTU)	1994	Governmental	Broad, portfolio of missions (transport, urban planning, trams)	Government	FR	Government departments, public sector officials, tram manufacturers	Knowledge retention, circulation, institutionalisation of important technical expertise	Moderate: €14 to 15 million /year
Finnish Heat Pump Association (SULPU)	1999	Market	Narrow, technology-specific (air source and ground source heat pumps)	Heat pump reseller, educator, government energy efficiency agency	FI	Industrial, financial, business, community and environmental groups	Create a market, maintain a network, develop standards, training	Small: €200,000 /year
Norwegian Electric Vehicle Association (NEVA)	1995	Civic	Narrow, technology-specific (battery electric vehicles)	Electric vehicle owners and manufacturers	NO	Vehicle owners, dealerships, local and global Original Equipment Manufacturers	Represent users, collect and disseminate information, promotion and marketing	Moderate: €3 million /year

meters, the rollout and how to use their meters to get their gas and electricity use “under control”. While its purpose is to spread the message to consumers, Smart Energy GB has a particular duty to make sure low-income, vulnerable and prepayment customers benefit from smart meters. Its role in innovation is focused on the diffusion of smart meters and improving the conditions for the diffusion of other low-carbon technologies addressing building energy demand. Smart meters – though not significantly challenging in technical or institutional terms – are expected to empower consumers to act on improving the energy performance of buildings and the adoption of low-carbon technologies [76].

Despite relative technical simplicity and user familiarity of IT-enabled control devices, the scale and rate of the smart meter rollout is demanding. Communicating with every single household in Great Britain during the national rollout of smart meters is a monumental technical challenge in itself, particularly so when operating within a low interest category (Sovacool et al. 2017). The rollout is behind schedule, with only 13.18 million meters installed after the third quarter of 2018 (i.e. 23.5% of the 56 million meters objective [77]). As Sovacool et al. (2017) calculated, in order to meet this target, the national smart meter campaign will need to see smart meters reach a dissemination rate of 40,000 per day every day for the duration of the program. This is largely why the government announced in 2019 that the smart meter rollout deadline would be extended from end of 2020 to 2024. Nonetheless, as Figure 2 indicates, the rate of installation has accelerated considerably since 2016 as suppliers have ramped up their installation capacity .

To facilitate consumer engagement, Smart Energy GB is governed by legally binding objectives to deliver the national campaign for the British public to support the installation of smart meters in homes and small businesses. Their long-term vision is to engage consumers across Great Britain and raise awareness of smart meters and their benefits to households, small businesses and the country as a whole. Smart Energy GB also promotes behavioural change to ensure consumers use the technology to change their attitudes towards energy consumption and reduce their energy costs. In addition, it assesses future applications of smart meter technology, energy data and highlights the potential for innovation in energy products, services and tariffs.

In terms of more concrete functions, Smart Energy GB's objectives as set out in its license are to:

- Build consumer confidence in the installation of smart metering systems by gas and electricity suppliers;
- Deepen consumer awareness and understanding of the use of smart metering systems (and the information obtained through them);
- Increase the willingness of energy consumers to use smart metering systems to change their behaviour so as to enable them to reduce their consumption of energy;
- Assist consumers with low incomes or prepayment meters, or consumers who may encounter additional barriers in being able to realise the benefits of smart metering systems due to their particular circumstances or characteristics, to realise the benefits of smart metering systems while continuing to maintain an adequate level of warmth and to meet their other energy needs.

Smart Energy GB will not operate indefinitely—its license is expected to terminate by the end of the smart meter rollout, when the program reaches its conclusion, i.e. it has been set-up as a temporary intermediary.

We also classify Smart Energy GB as a well-resourced intermediary that assists energy suppliers through its regulatory mandate. Although established by a government (political) entity, their funding comes from energy suppliers (and indirectly consumers). The energy supply license conditions, overseen by the government gas and electricity markets’ regulator Ofgem, set out that they must fund Smart Energy GB's national consumer engagement campaign. The projected expenditure for the whole, multi-year campaign, as set out in the *Smart Energy GB Consumer Engagement Plan 2017,* is just under £224 million (or 91 pence per household per year). The majority of this expenditure relates to public engagement campaigns and includes advertising, public relations, consumer research, and stakeholder communications and events.

According to their latest Annual Report [78], the results of their actions have been striking. Smart Energy GB has conducted more than 100,000 interviews with consumers to shape their campaign, have 58 million combined views of their promotional films on YouTube, and have trained 180 people across 88 different organizations to deliver smart meter information to local communities. To channel these funds and coordinate these activities, Smart Energy GB currently relies on 81 staff and 14 board members consisting of experts on marketing, behavioural change, and energy consumption. The key pillar of their

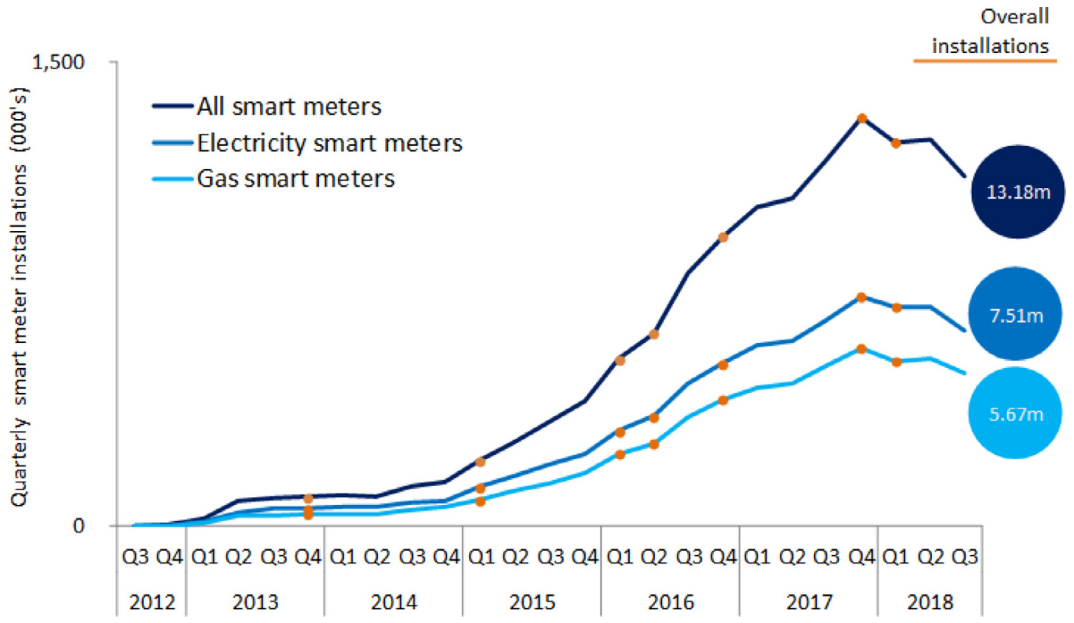

Fig. 2. Quarterly and overall installation of electricity and gas smart meters in Great Britain, 2012-2018
Source: Department for Business, Energy & Industrial Strategy (2018).

strategy involves awareness, outreach, and advertising. Throughout 2017, they promoted a slew of different messages and advertisements across print, television, radio, and other audio-visual channels (including social media and YouTube). These reached 98 percent of adults within Great Britain an average of 46 times across the calendar year [78]. They have also tailored their messages to young adults, the elderly, and children. For instance, SEGB implemented a campaign targeting 21 to 28 year olds through social media and short films as well as a "Smart Ideas" website (with tips on saving energy) which received almost 200,000 visits. They targeted people over the age of 65 without personal internet access by working with television stars (such as those appearing on MasterChef or the Great British Bake-Off) to hold low-energy cookery events, as well as a campaign featuring 1960s media icon Twiggy to develop "supersized in-home display" portraits. They lastly ran a three month pilot among 12 primary and secondary schools in Wales to raise energy saving awareness among young children. Consequently, through these efforts as a whole the Smart Energy Outlook claims that about 19 million adults without a smart meter state that they would accept one within the next six months, and that 82% of people who have adopted a smart meter have done at least one thing to save energy within their home [78].

Finally, Smart Energy GB reinforces incumbency in multiple ways. As already mentioned, they work closely with large energy suppliers (those with more than 250,000 domestic customers), who have the legal responsibility to set the results that they would like Smart Energy GB to achieve. This includes incumbents such as British Gas, EDF Energy, E.ON, Scottish Power, and SSE (among others). However, their furthering of incumbency extends well beyond that. Their public relations activity has centred on industries and media from the hairdressing, hospitality, construction, retail and environmental sectors. Smart Energy GB has explicitly worked with 20 employers with a potential staff reach of 1.4 million to promote smart meters, including large organisations such as Skyscanner, Hilton Hotels, Adnams Brewers, TfL and the NHS. They have worked closely with governmental incumbents including promoting smart meters among 141 elected representatives across England, Wales, and Scotland as well as 40 local councils. Sovacool et al. [79] add that the smart meters being promoted by Smart Energy GB can benefit incumbents in myriads ways, from the use of "big data" to better understand consumption profiles to the diffusion of energy storage devices, lower cost of pre-payment meters, remote reading and the avoidance of home calls, remote switching and disconnection, better services from energy companies, enhancing the use of energy management tools or contractors, and improving the efficiency and performance of national and local grids.

So, Smart Energy GB engages with end users of smart meters on behalf of incumbent energy interests (energy suppliers, grid operators, government) in the context of a top-down technological rollout programme. The primary focus of its intermediation activities is to improve societal acceptance of this rollout and to "grease the social cogs" of its implementation.

4.2. Energiesprong in the Netherlands (2013 to present)

Energiesprong, the "energy leap" initiative, was established in the Netherlands in 2013 (also now in the UK and France). It serves as an example of a market intermediary that promotes business model innovation for residential energy efficiency retrofits and zero carbon homes [80]. We classify it as a market intermediary, because it focuses on business model and market development, bringing together housing providers, construction firms, other private sector entities, government and the finance community to rethink how energy efficiency is delivered and financed at scale.

Under the Energiesprong model, a "market development team" brings together these stakeholders to implement integrated energy service business models for residential low carbon retrofits. Energiesprong market development teams do not undertake the retrofit measures, or provide the guarantees themselves, but instead act as an intermediary between the housing provider, government and contractors – essentially designing and implementing a radically new business model for the sector. This has typically involved a more industrialised approach to retrofits, one that utilizes "off-site" manufacturing of prefabricated components, driving down the cost for whole house retrofits through economies of scale and process innovation.

In the Energiesprong business model, customers are offered a comprehensive whole house retrofit, based on a guarantee of net-zero energy consumption. The Energiespong model promotes a "mass production" approach to the supply chain. This involves the factory or offsite production of insulated wall facades and modules that are integrated with renewable heat and power systems, drastically reducing installation times to less than a week and minimizing disruption [81]. The contractor then offers a 30-year energy performance guarantee for net zero energy consumption amortized over the calendar year. To achieve these cost reductions and enable energy performance guarantees to be offered, significant process innovation is required [82].

Interestingly, Energiesprong's mission is only temporary:

> In the Netherlands we are five years in and have reached a tipping point… There will come a time when we are obsolete because the market has been created. (Energiesprong UK)

Thus, they focus intently on creating the conditions for sustainable uptake of retrofit innovations that will eventually no longer require intermediation [81]. Figure 3 summarizes the proposition to the customer from an Energiesprong retrofit.

In terms of resources, Energiesprong was initially funded through a €45m grant from the Dutch government, and the setting up of the market development team, also now funded by membership contributions. A UK trial is now underway having secured funding through the EU Interreg scheme. It is hoped that the model will eventually become viable without subsidy. Approximately 1800 homes in the Netherlands have implemented Energiesprong "net zero" energy guarantees, of which 500 are new build and the remaining are pure retrofits, largely focusing on single-family semi-detached or terraced units [84]. Over this period, installation times have declined from two weeks to as quickly as one day. Its mid- to long-term plans are to scale up to 111,000 households in the Netherlands and to expand to France and the United Kingdom.

Energiesprong's market creation intermediation pushes boundaries along both dimensions of the dual challenge of transitions: the solution put forward challenges existing practices and technologies through radical process innovation, and challenges existing criteria in the construction sector (seeking to harmonize and "cement", as it were, zero-energy performance criteria in investment patterns). It engages with a new value proposition by seeking to reconcile high performance with low costs. The business model has thus far largely been trialled in the social housing sector, due to advantages concerning the relative uniformity of social housing estates, scalar effects, and the simplicity of dealing with large single clients. Additionally, social housing providers and municipal councils are potential early adopters as they have obligations to meet social and environmental goals for their tenants.

Lastly, Energiesprong shapes incumbency as their partnerships facilitate interactions with incumbent housing providers, construction companies (large UK and Dutch contractors Mears, Wilmott Dixon and VolkerWessels are members), trade bodies, energy efficiency suppliers as well as expert partners and policymakers, particularly at the local authority level. Moreover, it attempts to strengthen supply chains and the market base of retrofit service providers, seeking to "catalyse that innovation process - a large demand volume that collectively asks for a different type of offering from construction companies based on performance requirements instead of technical solutions" ([84]: 5). Its outcome-based procurement processes therefore seek to accelerate innovation primarily in incumbent construction firms. Its business platform is predicated on scaling up and reconfiguring these patterns of

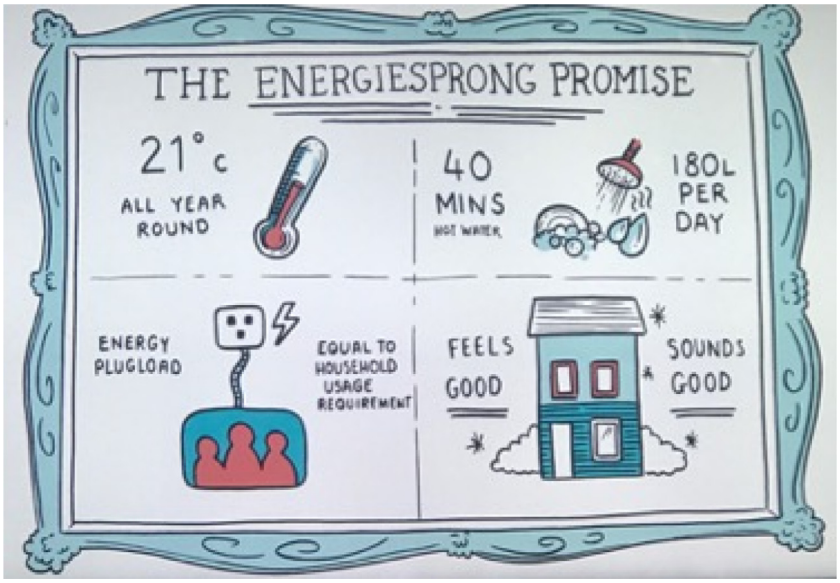

Fig. 3. Customer proposition of an Energiesprong Retrofit
Source: Energiesprong [83]

incumbency—as it notes, "these types of innovations will only happen if there is scale" ([84]: 13); if retrofit service providers develop packages that can be produced in flexible factors yet personalized with different components according to consumer preferences. As they note "only such a large volume of articulated demand will convince construction companies" to participate ([84]: 12).

4.3. CERTU in France (1994 to 2014)

CERTU (Assessment Centre for Networks, Transport, Urbanism and Public Works) was created in 1994 by national decree along with a reorganisation of the Ministry of Urbanism, Housing and Transport in France. It was established by fusing together the CETUR (Study Centre on Urban Transports) and the STU (Technical Service for Urbanism), both created in 1976. It was a governmental administrative and technical body serving as a technical competence centre with a mission to conduct relevant studies for the state, local authorities, or other public organisations [85]. We classify CERTU as a governmental (administrative) intermediary because it coordinates between state functions and more specialised and local governance and expertise. CERTU ceased to exist in 2014 when it was merged into a similar body with a broader remit including environmental, risk, and planning issues (CEREMA). We specifically discuss its role in the development and diffusion of modern tram technology as alternative urban public transport option.

Its primary functions were the provision of information and expertise, diffusion of best practices, circulation of experts, and normalisation and standardisation support. It was further linked to regional counterparts (CETEs, or Technical and Equipment Study Centres), which it "spearheaded", and to which it commissioned many local studies. It also collaborated with the National Federation of Urban Planning Agencies (FNAU) as well as the Grouping of Transport Regulatory Authorities (GART).

CERTU's competences and actions involved inherently decentralised government functions. It can be considered a governmental competence centre, primarily involved in the knowledge accumulation and circulation function, with a rather broad portfolio of competences. CERTU's main activities were linked to the development of technical knowledge and knowhow and to assist in their circulation. CERTU concentrated relevant expertise and acted as a centre for knowledge aggregation and diffusion for the various actors involved in public transport projects [86]. Outputs included the development of relevant statistics, surveys, expert opinions, technological innovation and experimentation, technical advice manuals and training workshops. It also participated to the framing and shaping of visions, namely by contributing to the development of technical standards, norms and regulations. In terms of trams specifically, CERTU focused intently on standards, problem-solving, and learning, whereas the professionalization of service-oriented intermediaries (e.g. technical consultancies and design studios) made local implementation easier and more appealing to clients and the general public.

Turnheim and Geels [87] write that CERTU developed technical manuals and evaluation guidelines on trams, conducted user observations and surveys, and contributed to guidelines for evaluation and learning. Through this technical support, CERTU exerted a significant influence on the overall diffusion of trams in France, and specific adoption by local authorities. Although trams had widely diffused in European (and French) cities in the early twentieth century, most networks had been dismantled by the 1950s. The development of "modern trams" in France from the 1970s hence constituted an entirely new proposition, which required dedicated innovation and new institutional strategies. Modern trams first emerged locally as radical interventions on behalf of urban planners seeking to challenge the material and institutional dominance of the private car [87]. CERTU's main role then was to address technical knowledge deficits in the inherently technical aspects of tram design and performance, particularly intermediating knowledge (urban to national, national to local, project to project) with a view at consolidating, circulating, and shaping technical criteria.

In addition, CERTU, along with other organs of state coordination, was instrumental in the success of the development of a "French tram school", notably by supporting successful implementation projects. This generated additional coherence to a multi-level expertise network supporting government action, reinforcing a strategically guided vision to develop modern trams around values of technological excellence with high export potential [87]. CERTU thus structured the emerging knowledge and competence in the field of local tramway project implementation, making highly technical issues accessible to local decision-makers and enabling the circulation of experts. With support from CERTU, Figure 4 reveals how the tramway proposition in France grew considerably, expanding to 25 urban areas as of 2016, 1.6 million annual journeys recorded, and hundreds of kilometres of new track being installed [88].

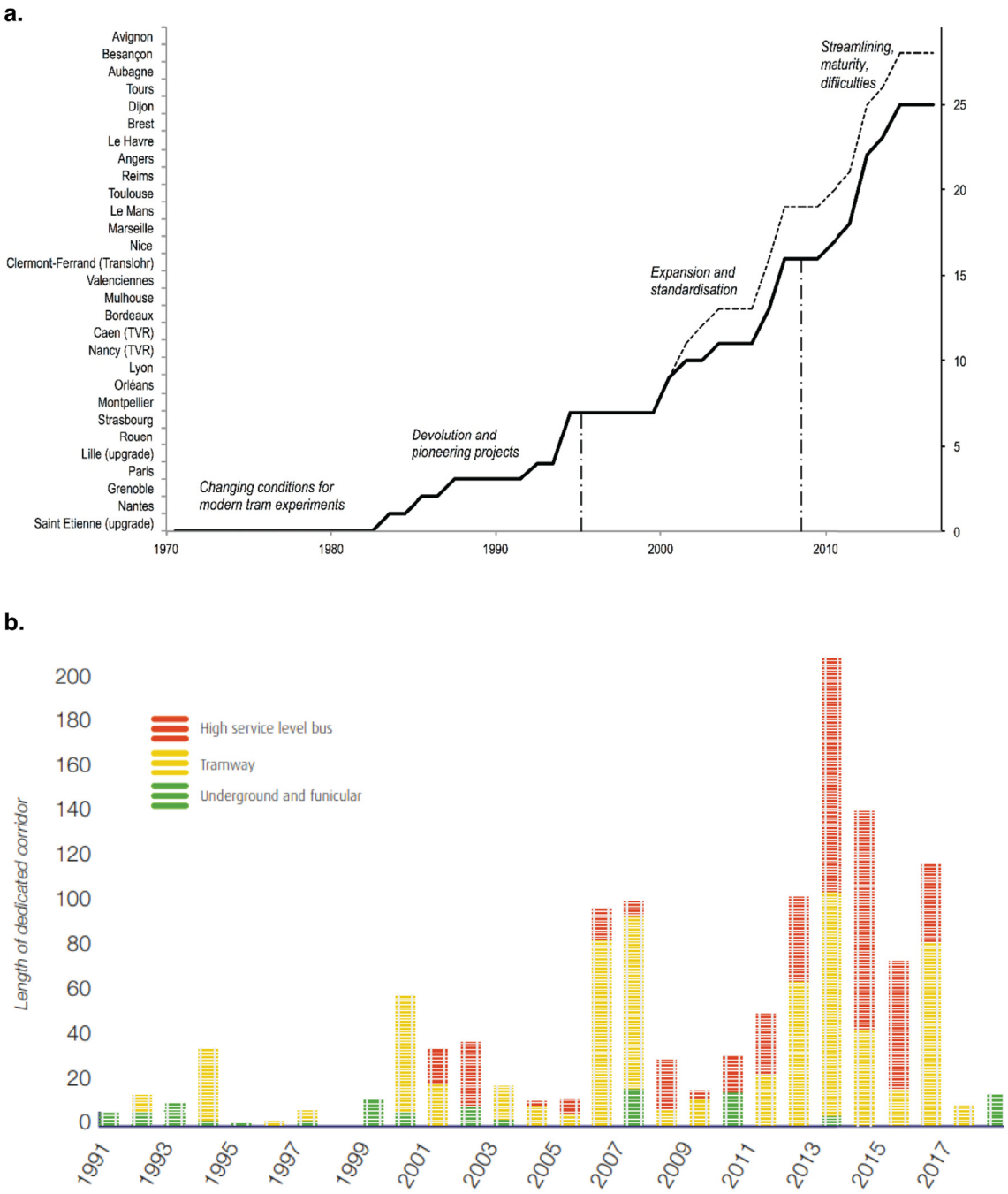

Fig. 4. Growth of the French tram network
a. Top panel: Modern tramway diffusion in French cities (solid line: tramways; dotted line: tramways and rubber-tired tramways) (Source: [87])
b. Bottom panel: number of kilometres of public transport in dedicated corridor brought into service annually (past and projected) (Source: Ministry for Ecology, Sustainable Development and Energy [88].

The CERTU case has an additional level of ambition insofar as it sought to contribute to a domestic blueprint for modern trams that could be later exported, in conjunction with other public bodies and a strong national industrial partner. Alstom [89], the main French tramway rolling stock manufacturer, claimed that 2300 Citadis tramways have been sold worldwide since 2000. Many other companies are now exporting skills and knowledge (e.g. project development and construction for Veolia, operations for Keolis and SNCF), with 100 modern tramway lines in 15 different countries built or supplied by French companies [90].

As such, CERTU was a comparatively well-funded intermediary. Although it received a guaranteed line item from the state budget, it also benefitted separately from more regional CETE work. In 2010, it had almost 170 experts (over 40 of which were dedicated to "transport infrastructures and services") and an overall budget of €14.5 million for the entire institution. The scope and strategic relevance of its activities further explains the size of this budget.

CERTU has cemented forms of incumbency in various ways. Most directly, CERTU was particularly instrumental in supporting the local implementation of tramways, hence supporting diffusion by making tram adoption decisions at the municipal level more streamlined and accessible. This, of course, has benefitted incumbent actors from neighbouring regimes such as the railway industry (in large part Alstom) as well as urban planning and state strategic interests. As such,

CERTU did not “arbitrate” for or against the tram, but rather contributed to its success by lifting some of the knowledge and expertise barriers and systematising learning. Governmental incumbents such as those at the Ministry of Transport or frontrunner committed mayors also worked with and drew from CERTU's expertise, as did a larger number of actors fulfilling emerging intermediary positions such as technical consultancies and design studios. Most broadly CERTU has reinforced the perceived effectiveness of state action on public transport by bringing together “recipes that worked” or in which the French State had vested interests.

4.4. Finnish Heat Pump Association (SULPU) in Finland (1999 to present)

The Finnish Heat Pump Association (SULPU) was established in 1999 with the aim of creating a credible heat pump market (air to air, air to water, exhaust air, and ground source heat pumps) in Finland ([91]). It is another example of a market intermediary. It is a trade association established by a heat pump reseller, an educator researching heat pumps at a university and the government energy efficiency agency. Its founder, Jussi Hirvonen, became a “champion” for heat pump technology in 1994. He set up a heat pump consultancy business and raised awareness directly with customers through information days he held across 150 Kesko hardware stores [92]. Hirvonen also established technical and installation training for store staff.

SULPU was created in order to bring disparate heat pump companies (incumbent and new) together to generate a common, credible channel for promoting heat pumps to government, ministries and other public authorities, as well as the media. SULPU has described heat pumps as a fairly affordable and modular way to decarbonize the household heating sector in Finland, displacing fossil fuels, increasing self-sufficiency, and meeting European targets for energy efficiency simultaneously [14,93]. To fulfil this promise, the heat pump sector also needed better standards, especially for training, certification and quality control. Certification schemes for both heat pumps and installers were important for creating customer confidence [94], and together with training had the potential to improve the expertise and credibility of the industry in the early 2000s .

SULPU thus contributed toward these standards, and it also created links with international associations and organisations, such as the European Heat Pump Association ([95]) and the IEA Technology Collaboration Programme on Heat Pumping Technologies [96], transferring knowledge from other countries to Finland [97]. Finland was accepted as an official member of EHPA's quality control committee in 2009, and a national quality committee was established, consisting of three heat pump manufacturers, Sitra (Finnish Innovation Fund), SKLL (Finnish Refrigeration Enterprises Association), SuLVI (Finnish HVAC Association) and VTT (Technical Research Centre of Finland) [98]. Lastly, one of SULPU's aims was to develop tools to track and compile statistics on the sector's development and growth and they have provided these since 1996 (see [99]). SULPU's strategy has been to “influence heat pump sector development in national and international networks” and “support the growth of the sector, provide training and improve quality together with legislators and authorities.” ([93], translated from Finnish, p.n/a). This includes targeted activities such as aiming to influence policymakers and other key stakeholders especially when new regulation or decrees have been planned or prepared.

Perhaps SULPU's greatest impact on the Finnish heat pump market has been to create a common, trusted voice for the sector [97], active political lobbying and the creation of policy incentives. SULPU organises an annual heat pump day which has often been attended by ministerial level stakeholders [92], showing activity has been recognised at government level. The association was, for example, the recipient of the Finnish Government's Renewable Energy Action Prize in 2009 . Heiskanen et al. [91] give SULPU credit for legitimising heat pumps within national and EU policy. During 2008-2010, significant lobbying by SULPU (and the European Heat Pump Association) to get heat pumps recognised as a renewable resource under the Renewable Energy Directive was successful. This subsequently led heat pumps to be included in the national energy aid in Finland in 2011-2012. As part of that policy, which provided grants for building heating system renovations, heat pumps received 20 million Euros, increasing sales by 72% compared to previous year [92]. SULPU was also actively involved in the setting up of the Finnish Clean Energy Association in 2013 [92], an umbrella organisation for renewable energy in Finland, and Hirvonen sits on its board [100].

In 2018 SULPU had 164 members, consisting of companies importing heat pumps, manufacturers, resellers, installers, designers and training organisations. It has a dozen associated members and a few individual private members located across Finland. SULPU's annual turnover is just over 200,000 Euros. The association is financed mostly by membership fees (80%), and by project funding, income from advertising on their website, and training and certification fees (20%). Hirvonen's firm RESplus Oy provides executive management services to the association and SULPU buys external administration services for six months of the year. As Heiskanen et al. [91] have noted, “Since SULPU was established, the heat pump sector has started to emerge from fumbling attempts by small local companies to co-operate into a globally relevant industry” (p.1898). In April 2018, there were approximately 850,000 installed heat pumps in Finland, a country with a population of 5.5 million people, following steady diffusion (see Figure 5). There are three Finnish heat pump manufacturers (Gebwell, Oilon and Lämpöässä), while most international models (e.g. Daikin, Hitachi, Mitsubishi, Panasonic, Toshiba) are also available on the Finnish market. Approximately 70% of new built small houses choose a heat pump [101], and roughly 5,000 oil boilers are replaced with a heat pump each year [101].

SULPU's efforts intercede with those of existing incumbents in multiple ways. Interestingly, it was founded in close connections with Rovaniemi University of Applied Sciences (the university was developing a heat pump testing and teaching laboratory) and Motiva (the Finnish energy efficiency agency). Hirvonen, meanwhile, had his own connections with IVO (Finnish nuclear power plant operator where he had worked as an energy technology engineer for 10 years prior to getting into heat pumps) and IVT Industrier AB (Swedish heat pump manufacturer which became world number one in 2004 before being acquired by multinational company Bosch) [92]. Hirvonen also faced resistance in his early heat pump days from other incumbents, especially the oil heating sector who questioned heat pump technology [92]. Essentially, SULPU's primary mission has been to use its connections with multiple incumbents to grow the Finnish heat pump market. However, at the same time, it has worked against other incumbents in the energy sector, including the established district heating regime and oil-based heating. Over time, it has transformed from a “niche” actor to an incumbent intermediary. SULPU's longer term plan is to double the size of the sector from 0.5 billion Euros to 1 billion Euros by 2025, perhaps also doubling in size institutionally.

So, rather than radically stretching technical aspects (heat pumps technology being relatively mature), SULPU focussed on transforming institutional dimensions towards greater legitimacy and acceptability of heat pumps, firmly embedding the industry in the renewable energy landscape.

4.5. Norwegian Electric Vehicle Association (NEVA) (1995 to present)

The Norwegian Electric Vehicle Association (NEVA), or *Norsk elbilforening*, was created in 1995. The organization was then called “Norstart” and was established by actors who wanted to both promote the development of an EV industry in Norway (a commercial goal) but also enthusiastically endorse a favoured and exciting form of mobility (a social goal). It changed its name to the Norwegian Electric Vehicle Association in 2011 and the organization became more focused only on consumers. NEVA seeks to be the “first choice” for EV owners when it

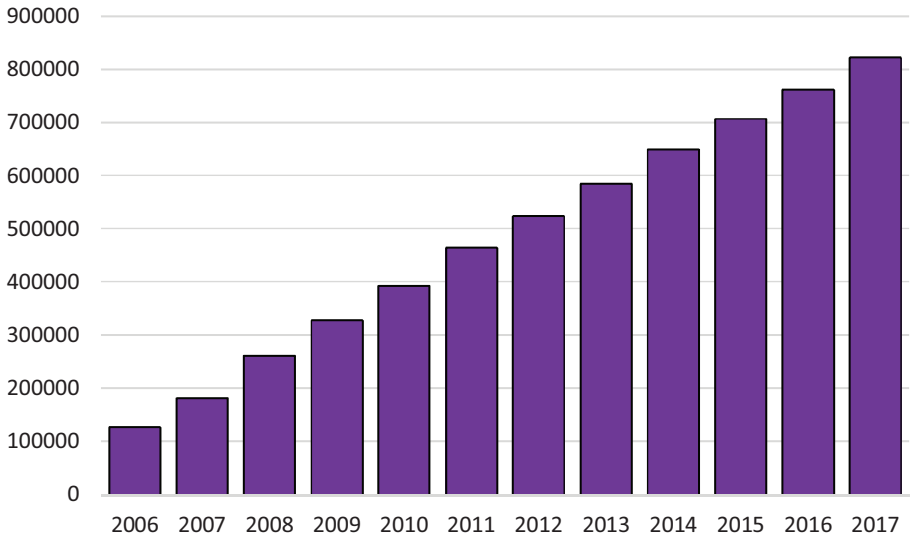

Fig. 5. Cumulative installations of heat pumps in Finland, 2006 to 2017
Source: Modified from [14] and SULPU 2018.

comes to representing their interests; it also seeks to create a critical mass to lobby for improved conditions, regulation, and infrastructure in support of EVs. NEVA ([102]: 1) argues that they already represent "the majority of electric car owners in Norway." Haugneland et al. ([103]: 2) write that "the Norwegian EV Association represents the Norwegian EV owners and cooperates with policy makers, the electric car industry and other organizations for the successful introduction of electric vehicle." It is now entirely user led and mostly user funded; it operates according to a charter and mission; and despite its quasi-commercial focus (stimulating industry), it is also not-for-profit.

One core function NEVA fulfils is to provide an important source of information and guidance regarding electric mobility for governmental institutions, local authorities, researchers and private consumers. For instance, NEVA conducts independent consumer research. Every year since 2012, they have designed and managed a national survey among EV owners, one which has fairly high response rates (between 21% and 33%, depending on the year) and a large sample (7,780 respondents in 2015) [104]. The survey has noted, for example, that current EV designs can fulfil most of the traveling needs of drivers in terms of addressing range anxiety, as well as considering EV as primary vehicle (not secondary); that respondents become more conscious about their energy use after they bought their EV; and that one-quarter state they will consider installing a solar panel on their house. Other forms of knowledge building include contributing to the *World Electric Vehicle Journal* and organizing an annual conference and convention (the "Nordic Electric Vehicle Summit"). A final function is that NEVA provides consultancy regarding EVs and charging, especially charging consultancies directed at apartment or multi-unit housing.

As both Norstart and the NEVA, the organization is funded by its members. It charges an annual membership fee of about 50 euros (460 NOK), which supports most of its operations, although it receives some state funding. As of early 2018, it had more than 60,000 members and 22 employees, although this is set to expand considerably, given that 7 new employees had already been hired in 2018 with three more expected. Based in part on NEVA's leadership, sales of both battery electric vehicles and plug-in hybrid electric vehicles have grown considerably, making Norway a European and global leader [105]; as Figure 6 also summates, more than 200,000 EVs were on the road in Norway at the end of 2017. NEVA has also exerted a significant impact on national policy, with the Norwegian Parliament deciding (based on NEVA input) on a national goal that all new car sales in 2025 will be EVs. The national government goal is to reach 400,000 EVs in Norway by 2020. They also aim to "promote Norway as a best case for electric vehicles policy to Europe and the rest of the world" ([102]: 2).

In terms of incumbency, NEVA collaborates closely with incumbent car producers (such as Nissan, Volkswagen, and Honda) as well as newer entrants (such as Tesla), charging operators, the Norwegian government, and environmental organizations, among others. When they were Norstart, they worked to promote a Norwegian EV industry (Buddy and Think) by creating a network for the industrial actors of EVs in Norway. To accomplish this mission, Norstart promoted economic incentives for EVs such as the exemption of regular purchase tax, exemption of company car tax and free parking, which did strengthen the power of the industry. Haugneland et al. [103] note that the NEVA's mission is to work with incumbents, as they seek to offer "valuable input" to Norwegian planners and EV industrial firms. As such, NEVA is a member of both the European Association for Electromobility (AVERE) and the World Electric Vehicle Association (WEVA).

5. Reflection and implications: Intermediation processes, strategies, and future research

Our cases reveal the rich mosaic of disparate motives for the reasons incumbent-oriented intermediaries were set up (whether their origins were governmental, market or civic oriented), the functions that they fulfil and activities conducted. Knowledge brokerage, knowledge circulation and networking between actors were the primary intermediation functions performed in our cases, in clear connection to the core functions of innovation intermediaries (e.g. [15,42]), but we also see evidence of important institutional work being performed by intermediaries (e.g. developing standards, lobbying and influencing policy frameworks). Table 5 offers a comparative overview of the key intermediation functions and activities observed in our different cases, based on the distinctions synthesised from the literature, suggesting that they all cover a similar breadth of intermediation activities.

The remainder of this section discusses a number of findings arising from our specific focus on incumbent-oriented intermediaries, and the extent to which this orientation shapes intermediation strategies and activities.

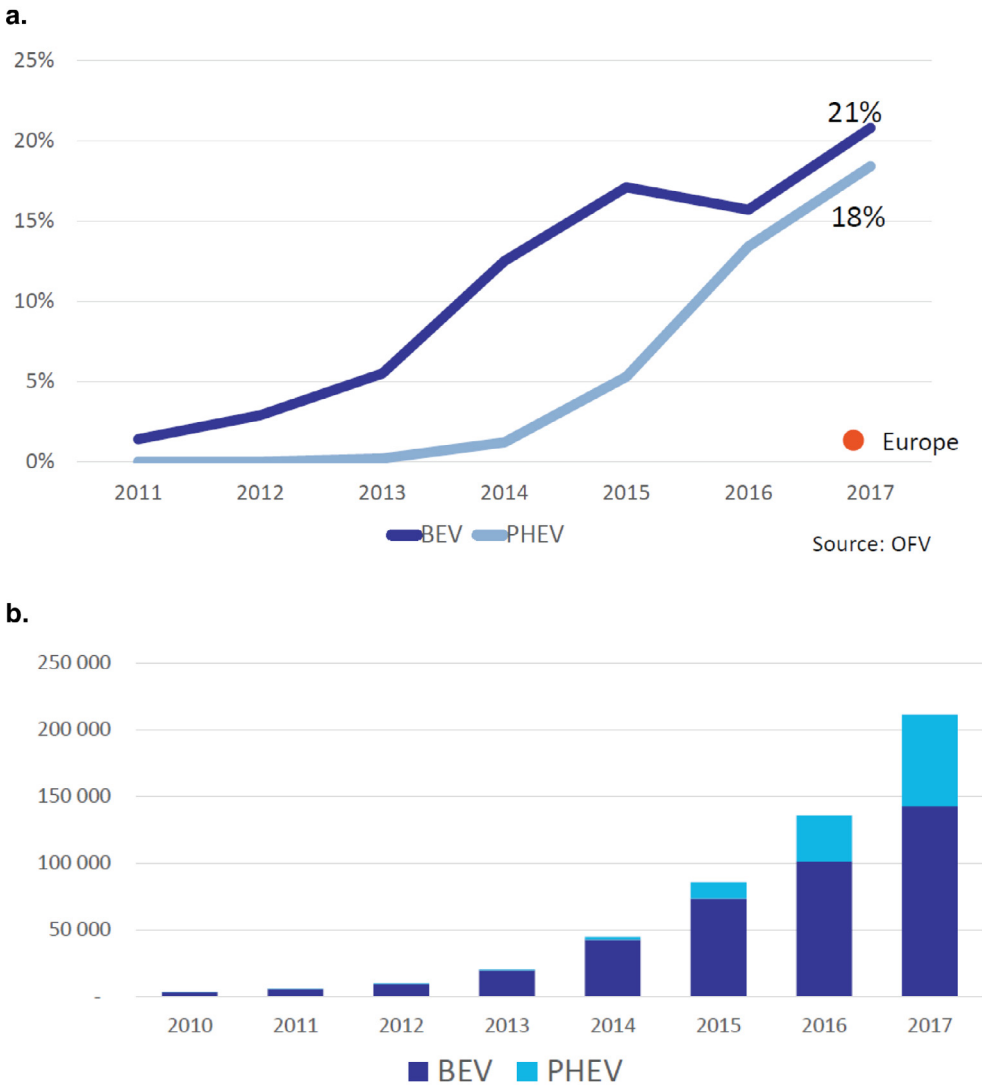

Fig. 6. Share and volume of electric vehicle adoption in Norway, 2010-2017
a. Top panel: percentage of new car sales
b. Bottom panel: overall fleet of electric vehicles
Source: [102].

5.1. Some incumbents engage proactively with transitions and can be assisted by incumbent-oriented intermediaries to address related challenges

Our cases confirm that incumbents (with significant expertise, capabilities, legitimacy related to working "at the large scale") can become privileged partners for market diffusion (e.g. the execution of roll-out programmes such as Smart Energy GB). Furthermore, involving incumbents in the fulfilling of societal missions may become particularly important when there is high-level political momentum and commitment around a particular technical option (as in the case of Smart Energy GB, NEVA, SULPU), or when material and infrastructural lock-ins are interpreted as requiring change from within (as in the case of Energiesprong), justifying transformative strategies that leverage the significant resources and influence that certain incumbent actors may possess. In other cases, incumbent-oriented intermediaries benefit from a drive for flagship industrial development to draw from *existing* capabilities in pursuing *new* goals. In such cases, certification and standard-setting are often interpreted as benefiting from the authoritative credibility linked to incumbency (e.g. "state action" and "technical expertise" for CERTU, "technical expertise" and "international embeddedness" for SULPU).

5.2. Incumbent-oriented intermediation strategies are further determined by their specialisation and processual focus

Our cases also exhibit, or at least reflect, a variety of strategies and tactics of intermediaries engaging with incumbent actors. Two dimensions are particularly relevant. First, intermediation strategies differ according to the specialisation of incumbents considered, whether these are a) specialists in the focal domain (e.g. energy incumbents engaging with energy transitions), or b) specialists in a different domain (e.g. ICT incumbents engaging with energy and/or mobility transitions). Second, intermediation strategies differ according to the kind of process considered, whether this is a) supporting the development and diffusion of innovation, or b) supporting organisational transformation (through e.g. re-skilling and diversification strategies).

Concerning our cases, Table 2 (above) shows that most of the intermediaries examined have a narrow set of technical competences, related to a specific sector (e.g. Energiesprong) or even a specific technological option therein (e.g. Smart Energy GB, NEVA, SULPU), while some have much broader technical competences (e.g. CERTU). The cases also show evidence of involvement in different processes relevant to low-carbon transitions. Smart Energy GB is stewarding the

Table 5
Intermediation functions and activities of five incumbent-oriented intermediaries

(Note: grey = core or central function, white = no involvement or indirect function).
Source: Authors.

	Smart Energy GB (UK)	Energiesprong (NL)	CERTU (FR)	SULPU (FI)	NEVA (NO)
Knowledge and learning (e.g., knowledge gathering, processing, facilitating experimentation, aggregation and circulation of knowledge, providing advice and support, training, commissioning research, or collecting and keeping statistics on the sector)	Yes	Yes	Yes	Yes	Yes
Networking (e.g., creating and managing networks, translating between actors and interests, trust building and conflict resolution, 0rganizing events)	Yes	Yes	Yes	Yes	Yes
Brokering (e.g., representing organizations, brokering between actors and interests, financial brokering by raising support)	Yes	Yes	Yes	Yes	Yes
Innovation & diffusion (e.g., innovation process management, technology transfer, connecting new technology and users, developing standards, experimenting with new applications)	Yes	Yes	Yes	Yes	No
Visioning (e.g., articulating expectations, stating visions, managing market and information campaigns)	Yes	Yes	No	Yes	Yes (around localism)
Institutional (e.g., political advocacy & lobbying, policy implementation, legitimizing institutional change)	Yes	Yes (focus on energy performance)	Yes (co-creation with industry)	Yes (focus on training and quality control)	No

adoption of 56 million electricity and gas smart meters (connected to in-home displays) across homes and small businesses in England, Scotland, and Wales. Energiesprong is seeking to create a self-sustaining market for zero energy retrofits in which it is no longer even needed as an intermediary. CERTU played an instrumental role in the development and local implementation of French trams. SULPU is aiming to create new patterns of incumbency that favour low-carbon heat pumps in Finland and across Europe. NEVA is seeking the adoption of 400,000 EVs in Norway by 2020. However, each case represents a particular way of supporting low-carbon transitions that differs from bottom-up niche development that is comparatively more oriented towards a) enabling change of *existing* infrastructures and systems *from within* (e.g. Smart Energy GB, Energiesprong, NEVA), and b) mobilising *existing* capabilities and actors from neighbouring domains (e.g. CERTU, Energiesprong).

Mobilising or engaging with incumbent energy actors in support of transitions in the energy sector is perhaps the more intuitive kind of tactic, and is linked to arguments about technology- or sector-specific skills, expertise, market presence, visibility, and political alliances. Smart Energy GB illustrates the diffusion-oriented end of this spectrum, an aspect of intermediation also discussed in Bergek [31]. Smart Energy GB is inscribed in a deliberate strategy of working with incumbents in the British electricity sector and has focussed on mobilising existing transactional arrangements (between large energy suppliers and final users) as a conduit for the governmental rollout of a specific metering technology. Energiesprong illustrates the other end of the spectrum, as it primarily engages with a variety of heterogeneous incumbents from within the building/construction, social housing and distributed energy industries to support the significant market transformation of the building stock towards higher efficiency standards. Many of the other cases fall between these poles of the spectrum.

Concerning those intermediaries involving actors from neighbouring regimes, CERTU is noteworthy as it mobilises its technical expertise (i.e. transport and urban planning) in support of a much broader portfolio of innovations and actors, relying in this case on a capacity to aggregate and translate technical information. In its specific involvement with tramway technology as a public transport alternative, it has primarily engaged in supporting development and diffusion (through e.g. knowledge circulation and standardisation). Similarly, Energiesprong is all about bringing together housing providers, construction companies but also distributed energy providers to create net zero energy buildings.

So, specialism and processual focus emerge as crucial markers of intermediation strategies and intermediaries enacting them. This link indicates that some incumbent-oriented intermediaries may also sometimes be niche intermediaries (cf. [5], concurrently or in the past (e.g. SULPU, NEVA).

5.3. Progress with transitions on the ground is likely to determine intermediation strategies

We may expect a stronger degree and perceived need of incumbent-oriented innovation intermediation in cases where shared understanding about the need to act on societal challenges has emerged, or innovative alternative solutions are sufficiently developed to warrant a shift towards their mainstreaming. This is specifically illustrated in the cases of Smart Energy GB, CERTU and NEVA, for which intermediaries support the deployment of specific innovations once they have acquired a degree of maturity. What the SULPU and NEVA cases also reveal is that intermediaries can become incumbent actors and adopt more incumbent-oriented strategies over their lifetime.

This last finding is largely aligned with observations within the field about a new phase of energy transitions, which presents quantitative shifts (accelerated diffusion) along with significant qualitative shifts (e.g. increasing focus on system interactions and integration, political and competitive struggles), and are likely to lead to greater engagement

of incumbent actors [106,107]. Accordingly, this particular phase of development is likely to raise the salience of incumbent-oriented intermediation strategies. For this reason, these actors become increasingly interesting and relevant to research.

The transient nature of intermediation and intermediation contexts is also highly relevant, but under-examined. A central question concerns the organisational fate of particular intermediaries, i.e. whether intermediation is likely to persist, or be needed, through time, whether intermediaries are disbanded, retreat, or re-create themselves once their mission is accomplished (cf. [5], see also [108]). Those intermediaries with the broadest remit (e.g. CERTU) are most likely to survive the test of time, as they perform intermediation functions along a number of fronts (multiple domains, actors, technologies, and spheres) and their existence does not hinge upon a technology-specific mission. On the other side of the spectrum, the Energiesprong case clearly shows that intermediaries with a more specific mission are likely (or even plan) to be disbanded once said mission is accomplished.

6. Conclusion

Incumbents do not always stifle low-carbon innovations or socially desirable practices and technologies - particularly when they are *enabled* by dedicated innovation intermediaries. Incumbent-oriented intermediaries may facilitate or enable specific kinds of transformative/systemic change, and address various aspects of the dual challenge of transitions [35] accordingly. In this study, we explored the contours of five incumbent-oriented transition intermediaries, why and how they were set up, what kinds of action they engage with, and the nature of their influence over the directionality of sociotechnical change.

Our case studies show that incumbent-oriented intermediation strategies, in the way we define them, can be observed in the realm of low-carbon transitions; these can be distinguished from intermediation strategies that actively avoid engagement with incumbent actors, but also those that seek only to maintain the status quo or interrupt other progressive intermediaries. Furthermore, our cases provide evidence that many of the traditional functions played by transitions intermediaries can be found in the strategies of incumbent-oriented intermediaries. Based on a very small sample, we can only intuit on the specificities of incumbent-oriented intermediation strategies, but in all our cases (and despite the intentional variety of our cases) we found a strikingly large number of functions being performed by each intermediary, as well as a particular emphasis on institutional functions.

Perhaps just as important, we confirm that incumbent-orientation is a topic worthy of interest, namely insofar as it likely bounds the scope of transition pathways supported (i.e. more reformist and reconfigurational than revolutionary), determines related intermediation strategies, and enables the exploration of a significant variety of forms.

Ultimately, our findings demand that we overcome the somewhat problematic assumption that transitions only come from radical outsiders (radical transformation), and that there may be a fruitful role for reconfigurational transformation (in which incumbents may have a role to play). On the contrary, incumbent actors may indeed be seeking to work with or create intermediaries to heed off the kind of creative destruction that such radical innovation may present to their existing activities. In this way, they are seeking to survive the evolutionary process of transition by having a stake in change and in so doing are already significantly shaping change (i.e. slowing down, accelerating, re-orienting, capturing, transitions in-the-making). Even incumbents involved in existing regimes can play an active role in niche development or regime reconfiguration, and we find evidence of how intermediaries enable such involvement.

We thus contribute to a growing subtlety in transitions studies that seeks to overcome the original “David vs. Goliath” myth and focusses on the various modes in which incumbents engage with transition efforts, the means mobilised, and the outcomes this is having on transformation pathways. This calls for more qualified understandings of the nature and processes involved in transformative struggles that can support greater engagement with the (non-)desirability of pathways and related strategies. Conceptual moves towards a typology of incumbent-oriented intermediaries would need to further elaborate on some of the dimensions explored in section 5, build on empirical evidence from other sectors, as well as seek to draw from the contrasting features of incumbent-oriented vs incumbent-avoiding intermediation strategies.

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Supplementary materials

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References

[1] N. Eyre, S.J. Darby, P. Grünewald, E. McKenna, R. Ford, Reaching a 1.5C target: Socio-technical challenges for a rapid transition to low carbon electricity systems, Philos. Trans. R. Soc. A (2018) in press.
[2] C. Figueres, et al., . Three years to safeguard our climate, Nature 546 (2017) 593–595.
[3] FW Geels, BK Sovacool, T Schwanen, S Sorrell, Sociotechnical transitions for deep decarbonisation, Science 357 (6357) (2017) 1242–1244.
[4] Rockstrom, J. et al., 2017. A roadmap for rapid decarbonisation, Science, 355, 1269-1271.
[5] P. Kivimaa, W. Boon, S. Hyysalo, L. Klerkx, Towards a typology of intermediaries in sustainability transitions: a systematic review and a research agenda, Res. Policy 48 (2019) 1062–1075.
[6] K.M. Weber, H. Rohracher, Legitimizing research, technology and innovation policies for transformative change: Combining insights from innovation systems and multi-level perspective in a comprehensive “failures” framework, Res. Policy 41 (2012) 1037–1047, https://doi.org/10.1016/j.respol.2011.10.015.
[7] J. Bessant, H. Rush, Building bridges for innovation: The role of consultants in technology transfer, Res. Policy 24 (1995) 97–114.
[8] J. Howells, Research and technology outsourcing and innovation systems: An exploratory analysis, Ind. Innov. 6 (1999) 111–129.
[9] A. Hargadon, R.I. Sutton, Technology brokering and innovation in a product development firm, Adm. Sci. Q. 42 (1997) 716–749.
[10] L. Klerkx, C. Leeuwis, Establishment and embedding of innovation brokers at different innovation system levels: Insights from the Dutch agricultural sector, Technol. Forecast. Soc. Change 76 (2009) 849–860.
[11] H. van Lente, M. Hekkert, R. Smits, B. van Waveren, Roles of systemic intermediaries in transition processes, Int. J. Innov. Manage. 7 (2003) 247–279.
[12] T. Moss, Intermediaries and the governance of sociotechnical networks in transition, Environ. Plan. A. 41 (2009) 1480–1495.
[13] C. Grandclément, A. Karvonen, S. Guy, Negotiating comfort in low energy housing: The politics of intermediation, Energy Policy 84 (2015) 213–222.
[14] S. Hyysalo, J. Juntunen, M. Martiskainen, Energy Internet Forums as Transition Intermediaries, Res. Policy 47 (2018) 872–885.
[15] J. Stewart, S. Hyysalo, Intermediaries, users and social learning in technological innovation, Int. J. Innov. Manage. 12 (2008) 295–325.
[16] K. Matschoss, E. Heiskanen, Making it experimental in several ways: The work of intermediaries in raising the ambition level in local climate initiatives, J. Clean. Prod. 169 (2017) 85–93 https://doi.org/10.1016/j.jclepro.2017.03.037.
[17] F. Polzin, P. von Flotow, L. Klerkx, Addressing barriers to eco-innovation: Exploring the finance mobilisation functions of institutional innovation intermediaries, Technol. Forecast. Soc. Change 103 (2016) 34–46 https://doi.org/10.1016/j.techfore.2015.10.001.
[18] A. Smith, T. Hargreaves, S. Hielscher, M. Martiskainen, G. Seyfang, Making the most of community energies: three perspectives on grassroots innovation, Environ. Plan. A. 48 (2016) 407–432.
[19] M. Martiskainen, P. Kivimaa, Creating innovative zero carbon homes in the United

Kingdom – intermediaries and champions in building projects, Environ. Innov. Soc. Transitions 26 (2018) 15–31.
[20] G. Seyfang, S. Hielscher, T. Hargreaves, M. Martiskainen, A. Smith, A grassroots sustainable energy niche? Reflections on community energy in the UK, Environ. Innov. Soc. Transitions 13 (2014) 21–44 https://doi.org/10.1016/j.eist.2014.04.004.
[21] F.W. Geels, J.J. Deuten, Local and global dynamics in technological development: a socio-cognitive perspective on knowledge flows and lessons from reinforced concrete, Sci. Public Policy 33 (2006) 265–275.
[22] T. Hargreaves, S. Hielscher, G. Seyfang, A. Smith, Grassroots innovations in community energy: the role of intermediaries in niche development, Global Environ. Change 23 (2013) 868–880.
[23] Späth, P., Rohracher, H., Von Radecki, A., 2016. Incumbent actors as niche agents: The German Car Industry and the Taming of the "Stuttgart E-Mobility Region." Sustain. 8. https://doi.org/10.3390/su8030252.
[24] I. Mignon, W. Kanda, A typology of intermediary organizations and their impact on sustainability transition policies, Environ. Innov. Soc. Transitions 29 (2018) 100–113 https://doi.org/10.1016/j.eist.2018.07.001.
[25] J. Schot, L. Kanger, G. Verbong, The roles of users in shaping transitions to new energy systems', Nat. Energy 1 (May) (2016).
[26] L. Kanger, J. Schot, User-made immobilities: A transitions perspective, Mobilities 11 (4) (2016) 598–613.
[27] W. Boon, E. Moors, S. Kuhlmann, R. Smits, Demand articulation in emerging technologies: intermediary user organisations as co-producers? Res. Policy 40 (2011) 242–252.
[28] R.E. Bush, C.S.E. Bale, M. Powell, A. Gouldson, P.G. Taylor, W.F. Gale, The role of intermediaries in low carbon transitions — empowering innovations to unlock district heating in the UK, J. Cleaner Prod. 148 (2017) 137–147.
[29] A. Smith, R. Raven, What is protective space? Reconsidering niches in transitions to sustainability, Res. Policy 41 (2012) 1025–1036, https://doi.org/10.1016/j.respol.2011.12.012.
[30] R. Raven, F. Kern, A. Smith, S. Jacobsson, B. Verhees, The politics of innovation spaces for low-carbon energy: Introduction to the special issue, Environ. Innov. Soc. Transitions 18 (2016) 101–110 https://doi.org/10.1016/j.eist.2015.06.008.
[31] A. Bergek, Diffusion intermediaries: A taxonomy based on renewable electricity technology in Sweden, Environ. Innov. Soc. Transitions (2020), https://doi.org/10.1016/j.eist.2019.11.004.
[32] A. Stirling, Energy Research & Social Science How deep is incumbency ? A ' configuring fields ' approach to redistributing and reorienting power in socio-material change, Energy Res. Soc. Sci. 58 (2019) 101239https://doi.org/10.1016/j.erss.2019.101239.
[33] B Turnheim, BK Sovacool, Forever stuck in old ways? Pluralising incumbencies in sustainability transitions, Environ. Innov. Soc. Transitions (2020) in press.
[34] S. Ansari, P. Krop, Incumbent performance in the face of a radical innovation: Towards a framework for incumbent challenger dynamics, Res. Policy 41 (2012) 1357–1374 https://doi.org/10.1016/j.respol.2012.03.024.
[35] R. Kemp, H. Van Lente, The dual challenge of sustainability transitions, Environ. Innov. Soc. Transitions 1 (2011) 121–124 https://doi.org/10.1016/j.eist.2011.04.001.
[36] M. Agrawal, G. Hariharan, H.R. Rao, R. Kishore, Competition in mediation services: modeling the role of expertise, satisfaction, and switching costs, J. Organ. Comput. Electr. Commer. 23 (3) (2013) 169–199.
[37] N. Kalaitzandonakes, J. Kaufman, X. Wang, Firm entry through e-commerce in the U.S. agricultural input distribution industry, J. Chain Netw. Sci. 3 (2) (2003) 123–133.
[38] R. Pal, V. Ramani, Will a matchmaker invite her potential rival in? J. Econ. Manage. Strategy 26 (4) (2017) 806–819.
[39] J. Meckling, J. Nahm, When do states disrupt industries? Electric cars and the politics of innovation, Rev. Int. Polit. Econ. 25 (4) (2018) 505–529.
[40] M. Dodourova, K. Bevis, Networking innovation in the European car industry: Does the Open Innovation model fit? Transport. Res. A: Policy Pract. 69 (2014) 252–271.
[41] Abbott, Kenneth W. et al., 2017. Theorizing Regulatory Intermediaries: The RIT Model, The Annals, American Academy of Political and Social Science, Vol. 670.
[42] J. Howells, Intermediation and the role of intermediaries in innovation, Res. Policy 35 (2006) 715–728.
[43] P. Kivimaa, M. Martiskainen, Dynamics of policy change and intermediation: the arduous transition towards low-energy homes in the United Kingdom, Energy Res. Soc. Sci. 44 (2018) 83–99.
[44] J. Fischer, S. Guy, Re-interpreting regulations: architects as intermediaries for low-carbon buildings, Urban Stud 46 (12) (2009) 2577–2594.
[45] N Parag, K. Janda, More than filler: Middle actors and socio-technical change in the energy system from the "middle-out", Energy Res. Soc. Sci 3 (2014) 102–112.
[46] P. Kivimaa, M. Martiskainen, Innovation, low-energy buildings and intermediaries in Europe: systematic case study review, Energy Effic. 11 (1) (2018) 31–51.
[47] S. Hyysalo, J. Juntunen, S. Freeman, Internet forums and the rise of the inventive energy user, Sci. Technol. Stud. 26 (1) (2013) 25–51.
[48] P. Kivimaa, Government-affiliated intermediary organisations as actors in system-level transitions, Res. Policy 43 (2014) 1370–1380.
[49] J Seyfang, N. Longhurst, What influences the diffusion of grassroots innovations for sustainability? Investigating community currency niches, Technol. Anal. Strategic Manage. (2016).
[50] R.E.H.M. Smits, S. Kuhlmann, The rise of systemic instruments in innovation policy, Int. J. Foresight Innov. Policy 1 (1/2) (2004) 4–32.
[51] L. Klerkx, C. Leeuwis, Balancing multiple interests: Embedding innovation intermediation in the agricultural knowledge infrastructure, Technovation 28 (2008) 364–378.
[52] M. Hodson, S. Marvin, Can cities shape socio-technical transitions and how would we know if they were? Res. Policy 39 (2010) 477–485.
[53] S. Kampelmann, S. van Hollebeke, P. Vandergert, Stuck in the middle with you: The role of bridging organisations in urban regeneration, Ecol. Econ. 129 (2016) 82–93.
[54] J. Backhaus, Intermediaries as innovating actors in the transition to a sustainable energy system, Cent. Eur. J. Public Policy 4 (1) (2010) 86–109.
[55] H. Rohracker, Intermediaries and the governance of choice: The case of green electricity labelling, Environ. Plan. A 41 (2009) 2014–2028.
[56] M. Hodson, S. Marvin, H. Bulkeley, The Intermediary Organisation of Low Carbon Cities: A Comparative Analysis of Transitions in Greater London and Greater Manchester, Urban Stud. 50 (2013) 1403–1422.
[57] B. van Mierlo, P.J. Beers, Understanding and governing learning in sustainability transitions: A review, Environ. Innov. Soc. Transitions 1–15 (2018).
[58] R. Raven, F. Kern, B. Verhees, A. Smith, Niche construction and empowerment through socio-political work. A meta-analysis of six low-carbon technology cases. Environ. Innov. Soc. Transitions 18 (2016) 164–180.
[59] Phil Johnstone, et al., . Policy mixes for incumbency: Exploring the destructive recreation of renewable energy, shale gas 'fracking,' and nuclear power in the United Kingdom, Energy Res. Soc. Sci. 33 (2017) 147–162.
[60] A.. Stirling, How Deep is Incumbency – Part 1, SPRU Working Paper. (2018).
[61] M. Tripsas, G. Gavetti, Capabilities, cognition, and inertia: evidence from digital imaging, Strategic Manage. J. 21 (2000) 1147–1161.
[62] W. Weitzel, E. Jonsson, Decline in Organizations: A Literature Integration and Extension, Adm. Sci. Q. 34 (1) (1989) 91–109, https://doi.org/10.2307/2392987.
[63] D. Leonard-Barton, Implementation as mutual adaptation of technology and organization, Res. Policy 17 (1988) 251–267 https://doi.org/10.1016/0048-7333(88)90006-6.
[64] M. Mone, W. McKinley, V. Barker, Organizational Decline and Innovation: A Contingency Framework, Acad. Manage. Rev. 23 (1) (1998) 115–132.
[65] M.L. Tushman, P. Anderson, Technological Discontinuities and Organizational Environments, Adm. Sci. Q. 31 (1986) 439–465.
[66] D. Levinthal, J. March, The myopia of learning, Strategic Manage. J. 14 (1993) 95–112.
[67] J.E. Dutton, J.M. Dukerich, Keeping an eye on the mirror: Image and identity in organizational adaptation, Acad. Manage. J. 34 (1991) 517–554.
[68] L Kanger, et al., . "Technological diffusion as a process of societal embedding: Lessons from historical automobile transitions for future of electric mobility, Transport. Res. D (2019) in press.
[69] M.P. Schlaile, S. Urmetzer, V. Blok, A.D. Andersen, J. Timmermans, M. Mueller, J. Fagerberg, A. Pyka, Innovation Systems for Transformations towards Sustainability ? Taking the Normative Dimension Seriously, Sustainability 9 (2017) 2253–2273.
[70] M. Diaz, I. Darnhofer, C. Darrot, J.E. Beuret, Green tides in Brittany: What can we learn about niche-regime interactions? Environ. Innov. Soc. Transitions 8 (2013) 62–75.
[71] K. Hockerts, R. Wüstenhagen, Greening Goliaths versus emerging Davids - Theorizing about the role of incumbents and new entrants in sustainable entrepreneurship, J. Bus. Ventur. 25 (2010) 481–492.
[72] D.J. Hess, The politics of niche-regime conflicts: Distributed solar energy in the United States, Environ. Innov. Soc. Transitions 19 (2016) 42–50.
[73] TNT Manders, et al., . Complexity, tensions, and ambiguity of intermediation in a transition context: The case of Connecting Mobility, Environ. Innov. Soc. Transitions 34 (2020) 183–208 March 2020.
[74] B. Flyvbjerg, Five Misunderstandings About Case-Study Research, Qual. Inq. 12 (2006) 219–245 https://doi.org/10.1177/1077800405284363.
[75] L.B. Fischer, J. Newig, Importance of actors and agency in sustainability transitions: A systematic exploration of the literature, Sustain. 8 (2016), https://doi.org/10.3390/su8050476.
[76] Sabine Hielscher, Paula Kivimaa, Governance through Expectations: Examining the Long-Term Policy Relevance of Smart Meters in the United Kingdom, Futures, 2018 ISSN 0016-3287.
[77] Department for Business, Energy & Industrial Strategy, Smart Meter Statistics: Quarter 1, 2018, BEIS, London, 2018 27 March 2018.
[78] GB. Smart Energy, Annual report and accounts - Year ended 31st December 2017, SEGB, London, 2018.
[79] BK Sovacool, P Kivimaa, S Hielscher, K Jenkins, Vulnerability and resistance in the United Kingdom's smart meter transition, Energy Policy 109 (2017) 767–781.
[80] Energiesprong, 2018a. The Netherlands – Energiesprong [WWW Document]. URLhttp://energiesprong.eu/country/the-netherlands/ (Accessed 5 August 2018).
[81] D. Brown, Business models for residential retrofit in the UK: a critical assessment of five key archetypes, Energy Effic. (2018), https://doi.org/10.1007/s12053-018-9629-5.
[82] L. Massa, C.L. Tucci, Business model innovation, Oxford Handb. Innovafion Manag. 27 (2013) 420–441.
[83] Energiesprong, 2018b. Presentation to the Ecobuild conference 2018.
[84] Energiesprong. 2014. Transition Zero.
[85] Lecomte, Alain and Jacques Roudier. 2011. Evolution de la gouvernance du Certu (Centre d'études sur les réseaux, les transports, l'urbanisme et les constructions publiques).
[86] G. Debizet, Déplacements urbains de personnes : de la planification des transports à la gestion durable de la mobilité, Mutations d'une expertise, Université de Paris 1 Panthéon Sorbonne, 2004.
[87] B. Turnheim, F.W. Geels, Incumbent actors, guided search paths, and landmark projects in infra-system transitions: Re-thinking Strategic Niche Management with

a case study of French tramway diffusion (1971-2016), Res. Policy (2019), https://doi.org/10.1016/j.respol.2019.02.002.
[88] Ministry for Ecology, Sustainable Development and Energy. 2012. The Tramway Revival in France. Available at http://www2.developpement-durable.gouv.fr/IMG/pdf/11001-2_Renouveau-tramway-France_GB-2.pdf.
[89] Alstom. 2017. Acivity Report 2016/2017. Available at http://www.alstom.com/Global/Group/Resources/Documents/CSR/ALSTOM%20RA%202016_UK_FINAL.pdf.
[90] Ville-Rail Transports. 2015. Export: ça roule pour les tramways français. Available athttps://www.ville-rail-transports.com/ferroviaire/22350-export-ca-roule-pour-les-tramways-francais/.
[91] E. Heiskanen, R. Lovio, M. Jalas, Path creation for sustainable consumption: Promoting alternative heating systems in Finland, J. Cleaner Prod. 19 (16) (2011) 1892–1900.
[92] Virkkunen, O., 2017. Uuden yritystoiminnan kehittäminen - Systeeminen näkökulma (Developing new business – Systemic perspective). Suomen keksintösäätiö.
[93] SULPU, 2018b. Suomen Lämpöpumppuyhdistys. Visio ja strategia. (Finnish Heat Pump Association. Vision and strategy). Available online:https://www.sulpu.fi/documents/184029/209175/Yhdistys-SULPU.pdf [Accessed 20 April 2018].
[94] a, E. Heiskanen, S. Hyysalo, M. Jalas, J. Juntunen, R. Lovio, The role of users in heating systems transition: The case of heat pumps in Finland, in: S. Juninger, P. Christensen (Eds.), Highways and Byways of Radical Innovation: The perspective of design, Kolding Design School, Kolding, DK, 2014, pp. 171–196.
[95] HPA, 2018. European Heat Pump Association. Available online: http://www.ehpa.org/ [Accessed 20 April 2018].
[96] IEA, 2018. About HPT. Available online:http://heatpumpingtechnologies.org/about/ [Accessed 20 April 2018].
[97] Lauttamäki, V., 2018. Geoenergia kiinteistöjen lämmitysratkaisujen markkinoilla Suomessa energiakriisien ajoista 2030-luvulle. Turun Yliopiston Julkaisuja, Sarja E, osa 29, Turun yliopisto. [Translated from Finnish: Geoenergy in the building sector heating market in Finland from the energy crises to year 2030. PhD thesis, University of Turku].
[98] Talotekniikka, 2010. Lämpöpumppualalle kansallinen laatukomitea. (Heat pump sector gets a national quality committee). Talotekniikka-lehti, 10.3.2010. Available online:https://talotekniikka-lehti.fi/lampopumppualalle-kansallinen-laatukomitea/ [Accessed 23 April 2018].
[99] SULPU, 2018c. Suomen lämpöpumpputilastot. (Finnish heat pump statistics). Available online:https://www.sulpu.fi/tilastot [Accessed 23 April 2018].
[100] Lähienergia, Hallituksen jäsenet. (Board members), Lähienergialiitto, Finnish Clean Energy Association, 2018 Available online: https://www.lahienergia.org/lahienergialiitto/hallitus/ , Accessed date: 23 April 2018.
[101] SULPU, 2018a. Lämpöpumppuinvestoinnit jo puoli miljardia vuodessa. (Heat pump investing reaches half a billion a year). Lehdistötiedote 1/2018.
[102] [NEVA] Norwegian Electric Vehicle Association. 2018a. "Norwegian Electric Vehicle Association: Summary." May. Available at https://elbil.no/english/about-norwegian-ev-association/.
[103] Petter Haugneland, Erik Lorentzen, Christina Bu, Espen Hauge, Put a price on carbon to fund EV incentives – Norwegian EV policy success, EVS30 Symposium Stuttgart, Germany, 2017 October 9 - 11, 2017.
[104] Petter Haugneland, Christina Bu, Espen Hauge, The Norwegian EV success continues, EVS29 Symposium Montréal, Québec, Canada, 2016, p. 2016 June 19-22.
[105] [NEVA] Norwegian Electric Vehicle Association. 2018b. Welcome to Norway the World's EV Capital. Oslo.
[106] J. Markard, The next phase of the energy transition and its implications for Research and Policy, Nat. Energy. (2018), https://doi.org/10.1038/s41560-018-0171-7.
[107] *forthcoming*, B. Turnheim, J.H. Wesseling, B. Truffer, H. Rohracher, L. Carvalho, C.R. Binder, Challenges ahead: Understanding, assessing, anticipating and governing foreseeable societal tensions to support accelerated low-carbon transitions in Europe, in: C. Foulds, R. Robinson (Eds.), Advancing energy policy: Lessons on the integration of Social Sciences and Humanities, Palgrave Pilot, 2018.
[108] Marvin Kant, Wisdom Kanda, Innovation intermediaries: What does it take to survive over time? J. Cleaner Prod. 229 (2019) s.911-930.